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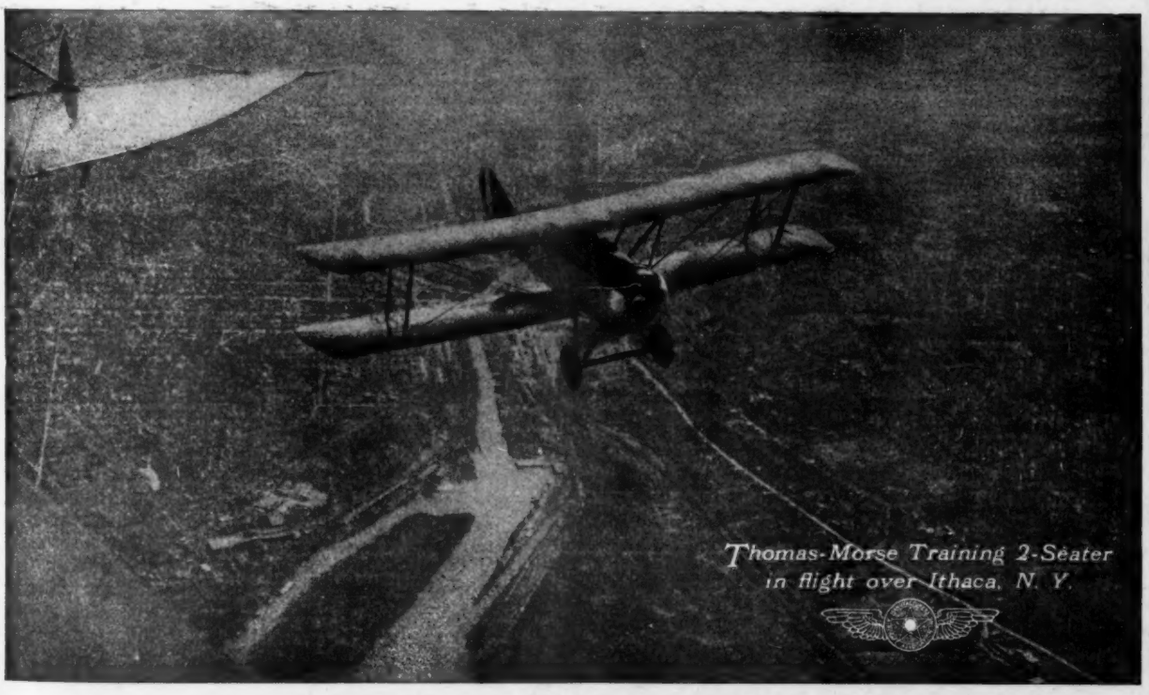

Thomas-Morse Training 2-Seater in flight over Ithaca, N. Y.

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Folding Wings

THE project of constructing wings in such a way that they can be folded back along the fuselage is a very attractive one and has engrossed the attention of designers for a number of years. The general public does not realize, however, how serious are the technical problems involved in the design of a folding wing truss. The stresses in the fittings are greatly increased by the use of such a truss and the structure is made considerably more complex. Additional external bracing members are required in small machines where it is desired to have the wings fold directly back along side the fuselage. The incorporation of a folding wing truss involves much less additional structure in large airplanes where the folding joint comes at the engine nacelle.

Engineers are not satisfied with the conventional and obvious method of folding wings as a permanent expedient, and some very interesting work is being done to effect improvements in this respect. The new Sablatnig monoplane, for example, folds the wings by rotating each one about its front spar into a vertical plane and then swinging them back alongside the fuselage, thus securing even greater compactness than is possible with the ordinary folding arrangement.

On the whole, it does not seem probable that folding wings will endure in connection with small airplanes, as equal convenience is secured with a cantilever wing which can be entirely removed from or replaced on the airplane in two or three minutes. The thick wing without external bracing affords an excellent solution of the problem of minimum storage space and quick dismounting and re-assembling.

Report on the R-38 Inquiry

THE report of the court of inquiry appointed to investigate the causes of the accidental destruction of the rigid airship R-38, which has just been issued, confirms the opinion, privately expressed after the disaster, that it was due to structural weakness.

The report, which is noteworthy for its frankness, states that the airship while flying at approximately 1,200 ft. over the Humber, broke in two, due to the failure of the structure to the rear of the after engine cars while being subjected to control tests.

The findings of the court of inquiry confirm evidence introduced at the inquest into the disaster. They say that fire, probably originating from a spark from electric wires, was mainly responsible for the large loss of life. They note that a quick reversal was being made at the time of the accident, bringing a heavy strain on the after-portion of the hull of the craft, due to the swing of the stern.

Then the court found, among other things, that "the requirements as to maximum height and speed, together with limit in length imposed by the only available construction sheds, necessitated the utmost economy in design, and it appears evident that in some cases there was lack of vital aerodynamical information as to the effect of these modifications on the strength of the structure."

The latter paragraph should be of particular interest to all those concerned with the development of American rigids. It is quite natural that the Z.R.2 disaster should have provoked considerable discussion as to the wisdom of having experimental ships for our government built abroad. It is equally natural for the incidental question to come up as to why such an important matter of policy was not thoroughly discussed before the disaster instead of afterward.

The answer to this latter question can and should be made perfectly clear to our minds. The main issue evolved is simply this, whether it is better to accept as fundamental the foreign designs and constructions, subsequently improving them where possible; or if it is better to base the principal reliance on our own designs and constructions with the incidental object of using foreign experience to the best possible advantage.

There are no *a priori* grounds on which such an argument could be based. It is simply a matter of ascertaining which system will produce the best results.

Free Flight Testing and the Wind Tunnel

FREE flight testing is just beginning to come into its own in America, as it is being realized that much of the data previously obtainable only in wind tunnels can be secured accurately from full-scale experiments. At the same time, however, it would be regrettable should any serious rivalry arise between the advocates of free flight testing and the wind tunnel method, as neither can attain its full usefulness without the other. Wind tunnel results are increased in value by the use of those scale corrections which can only be obtained from free flight testing, while free flight work must depend on the wind tunnel for determination of many of the factors involved as well as for calibration of certain instruments and other similar purposes. Instead of there being a need of growing rivalry between the two it is probable that they will come to resemble each other more closely.

Attention has already been given in these columns to the development of new types of wind tunnels designed to approach as nearly as possible free flight conditions and eliminate the necessity of scale correction. On the other hand, experiments have recently been undertaken by the National Advisory Committee for Aeronautics at Langley Field to determine the characteristics of wings and other objects by towing them below an airplane in flight, thus combining in free flight testing something of the simplicity and quickness of application of the wind tunnel test. These experiments should be invaluable as making it possible to fill in continuously that long gap which has previously existed between wind tunnel sizes and speeds and those of free flight tests.

Comparison of Airplane Performances

By R. J. Hoffman

In a previous paper* on the selection of wing sections the negligible influence of variation in section on the performance of an airplane has been shown. The selection has been governed by the results of wind tunnel tests of various sections with an additional body resistance, but without taking into consideration the scale effect. This method may be applied to the comparison of airplane performances. The simplicity of the factors employed will facilitate the investigations and there will result a fair estimate of performance.

The expression $\frac{W \times V_{min}}{b.h.p.}$, or the design factor, has a certain relation to the speed ratio, $\frac{V_{max}}{V_{min}}$, where V_{max} denotes the maximum speed, V_{min} the landing speed, W the weight of the machine fully loaded, and $b.h.p.$ the brake horsepower of the power plant. Variation in efficiency of the propeller is assumed to be constant and therefore is neglected.

If successive values of the design constant and the speed ratio for different machines be plotted on logarithmic cross-section paper, the former as abscissae and the latter as ordinates, it will be seen that the points obtained for any one machine bear a straight line relation to one another as shown in the accompanying graph.

A straight line on logarithmic cross-section paper represents a series of values which will satisfy an equation of the form,

$$y = cx^n$$

where y and x are variables and c and n constants. Substituting for y and x the speed ratio and the design constant respectively the following expression is obtained:

$$\frac{V_{max}}{V_{min}} \cdot c \left(\frac{W \times V_{min}}{b.h.p.} \right)^n$$

Evaluating c and n gives the equation the form of:

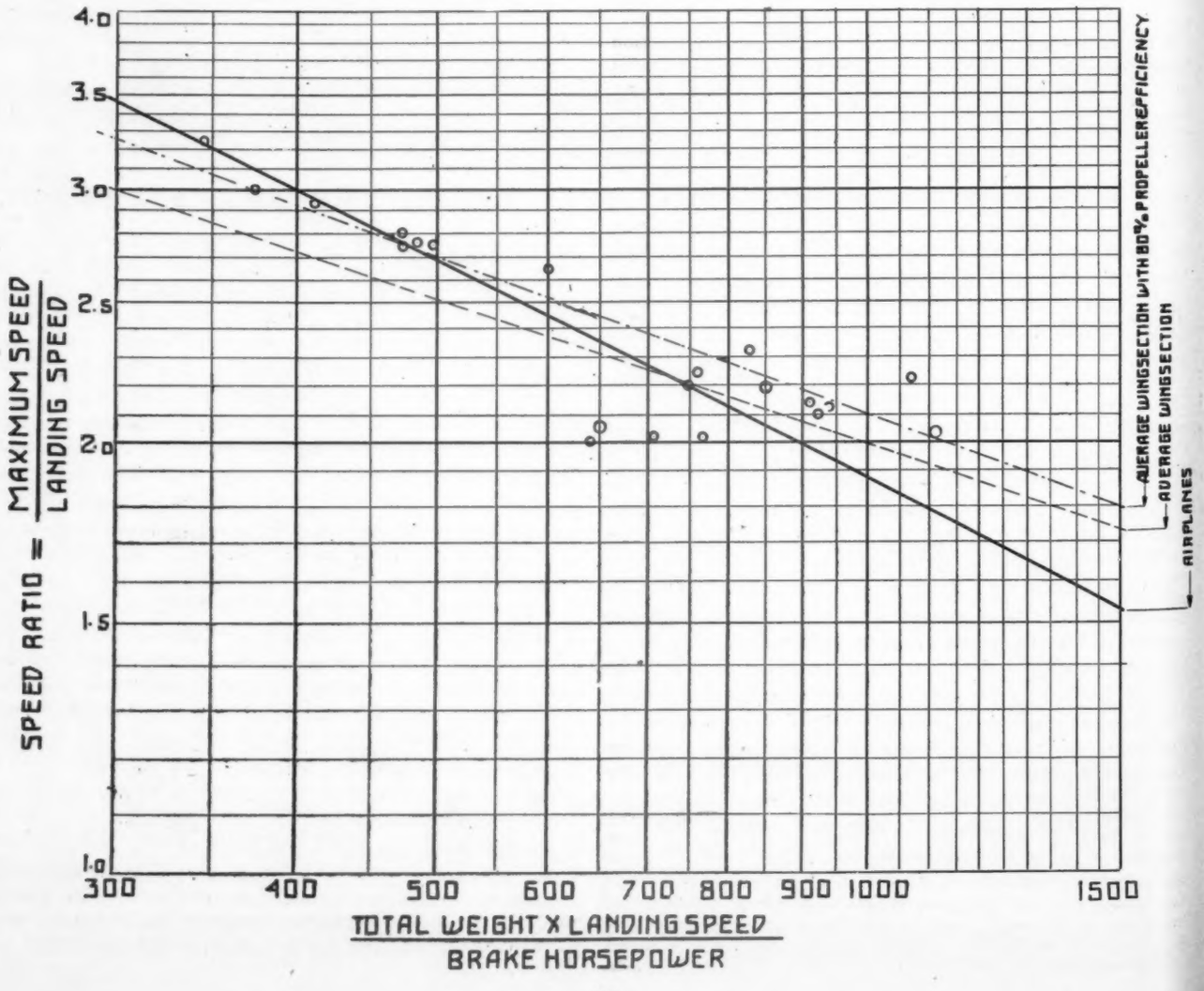
$$\frac{V_{max}}{V_{min}} \cdot 60 \sqrt{\frac{b.h.p.}{W \times V_{min}}}$$

or,

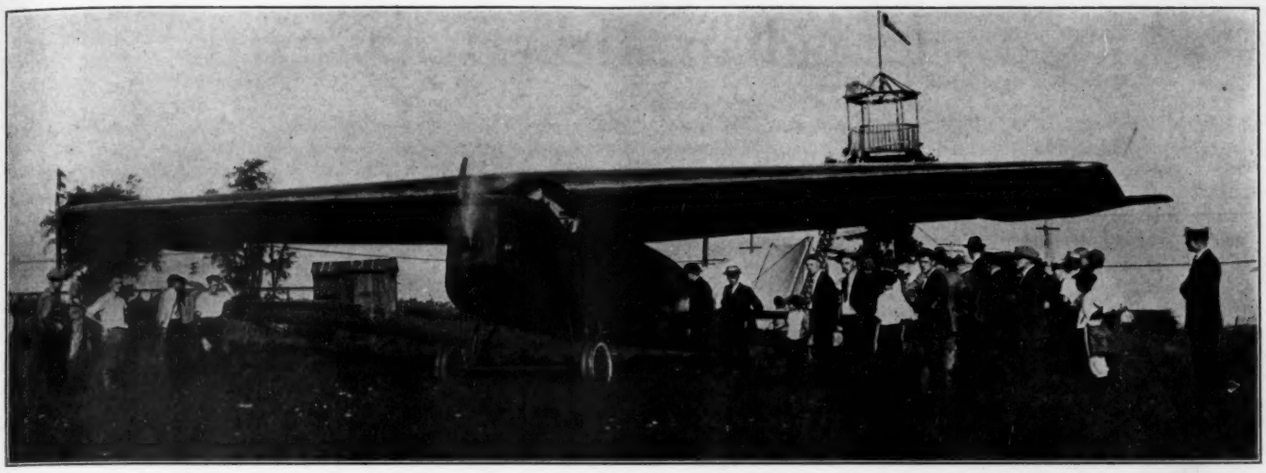
$$V_{max} = 60 \sqrt{\frac{b.h.p. \times V_{min}}{W}}$$

which may be an equation for comparing airplane performances by making possible the prediction of the performance of a design.

An analysis of the equation shows the speed of a machine to increase as the square root of the power, i.e. to double the



* Aviation and Aircraft Journal, Jan 1, 1920.



FOKKER 5-PASSENGER CABIN MONOPLANE ABOUT TO START FROM PHILADELPHIA FOR NEW YORK, CARRYING GOVERNOR HENRY J. ALLEN, OF KANSAS

Photo Underwood & Underwood

speed four times the power is required—which is contrary to the generally accepted cube relation.

Two dotted lines are shown on the graph: one following the characteristics of an average good wing section without the efficiency of the propeller, the other with a propeller efficiency of 80 per cent. The dotted lines neither coincide with, nor are they parallel to, the full line, thus showing the difference between theory and practice in airplane performances based on wind tunnel tests and calculated according to the well known square law.

The conclusions reached are that the main construction factors and the performances of an airplane can be formulated into a single relation to be used for a closer estimate of design and construction details, or for a convenient formula for racing machines.

Aero Club of Pennsylvania Bulletin

An item of news of interest to the members of the Club is the announcement that a branch of the Fokker airplane factory, from which came virtually all the best fighting machines used by Germany during the war, is a likelihood for Philadelphia as the result of a recent visit to this city of a representative of Anthony H. G. Fokker, the Hollander, who designed and built the machines bearing his name.

H. P. French, who came to the Industrial Bureau of the Philadelphia Chamber of Commerce, a direct representative of the airplane builder was placed in contact with that organization through Sheridan Taylor, its secretary, with some leading Philadelphia business men who are interested in aviation.

As a result of this conference, Mr. French returned to New York to get in contact with his company in Holland with a view to continuing negotiations looking to the establishment here of a factory and also for the starting of a campaign of education to make possible commercial aviation in the line of freight and passenger carrying here and throughout the East.

Mr. French said that Mr. Fokker not only was still producing the machines of the type which Germany used during the war, but also was turning his attention to greater cargo carrying and passenger carrying machines.

On September 13, word was received by several of the officials of the Club that one of the Fokker machines of the London-Paris type would fly to Philadelphia from the Mineola field, hurried plans for a landing field were made and the monoplane arrived in Philadelphia early in the afternoon having been in the air 75 min. from the time of its leaving the New York field. Later in the day it left the field of the Aero Service Corp. at 73rd and Elmwood Ave. and with Governor Allen of Kansas returned to New York. The machine, which was of the five passenger type, had been sent here to carry to New York a copy of the resolutions adopted at the luncheon of the Chamber of Commerce. Bert Acosta piloted the machine during the trip to and from Philadelphia.

A seaplane made for Secretary of the Navy Denby was recently given tests at the Philadelphia Navy Yard. Recently completed at the aircraft factory there, the machine was remodeled to give greater comfort and larger passenger accommodations.

The craft is a standard seaplane of the F5L type and was piloted in its tests by Commander Richardson, chief engineer of the aircraft factory and Lieutenant McFall. As soon as fully tested out the machine will be flown to Washington and turned over to the Secretary.

The stated meeting of the Club was held on evening of September 16 and plans were discussed whereby it is hoped greatly to increase the membership of the organization. The entertainment committee are working out plans for interesting meetings during the fall and winter months and lectures on popular subjects in connection with aeronautics will be given by well known aviation experts. Mr. Steinmetz, president of the Club has just returned from abroad after an extended trip in France and England.

Foreign Aeronautical News

The Netherlands

The Netherlands Aircraft Mfg. Co. announce that during the period from April 14 to August 6, 1921, 212 trips were made on the services between London and Amsterdam, with an intermediate landing at the new airport at Rotterdam. The Fokker F3 six-passenger monoplane is the type of plane that has been in use.

It is remarkable that, on this particular line, the freight traffic has gradually grown of far more importance than the carrying of passengers, especially in the direction of London to Amsterdam. The cargoes carried are of the most varied character imaginable, ranging from the famous diamonds from Amsterdam and men's underwear from London to live chickens and choice vegetables.

Fokker monoplanes, which carry their big loads with a motor of only 220 hp., are performing, according to statements issued recently by the management of the Royal Dutch Air Traffic Co., entirely satisfactorily, and it is expected that by next Spring monoplanes of the new Fokker F IV type will carry ten passengers and have either Napier or Liberty engines, will be put into service.

Uruguay

The Aero Club of Uruguay was recently founded to work for the benefit of national aviation.

An altitude of 1,650 ft. has been set by official decree as the lowest at which aviators may fly military aviation school airplanes for acrobatic performances. To fly lower than this altitude with Government aircraft, written permission must be obtained from the director of aviation.

Canadian Airharbors

Commercial aviation is rapidly developing on a sound basis in Canada and the legislation which regulates it is in no small measure responsible for this development. The need for suitable legislation to regulate commercial aviation in this country is well known and suitably illustrated by the "Analysis of Aircraft Accidents" recently made public by the Manufacturers' Aircraft Association and published in the Sept. 26 issue of AVIATION AND AIRCRAFT JOURNAL. We publish herewith the first installment of detailed descriptions of licensed Canadian airharbors so that, incidentally, machines going to Canada from this country can make use of them, and, principally, so that our readers can see fully the strides being made in the commercial aviation race by our northern neighbors.

In this connection the part of Canadian Air Regulations which provides for the licensing of airharbors is interesting. Part III, Sections 18 to 32 incl. read as follows:

Airharbors

18. No place, building, or work shall be used as an airharbor unless it has been licensed as herein provided.

19. Licenses to airharbors may be issued by the Air Board and may be made subject to such conditions respecting the aircraft which may make use of the airharbor, the maintenance thereof, the marking of obstacles in the vicinity which may be dangerous to flying and otherwise, as the Air Board may direct.

20. A fee of ten dollars shall be payable for a license for an airharbor.

21. The license of an airharbor may be suspended or canceled by the Air Board at any time for cause and shall cease to be valid two weeks after any change in the ownership of the airharbor, unless sooner renewed to the new owner.

22. Every licensed airharbor shall be marked by day and by night as may be from time to time directed by the Air Board.

23. The owner of any licensed airharbor shall be permitted to charge for the use of the harbor or for any services performed only such fees as have been approved by the Air Board for such airharbor. The tariff shall be prominently posted up at the airharbor.

24. No person shall without authority of the Air Board:—
(a) mark any unlicensed surface or place with any mark or display any signal calculated or likely to induce any person to believe that such surface or place is an airharbor or emergency alighting ground.
(b) knowingly use or permit the use as an airharbor of any unlicensed place.
(c) knowingly use or permit the use of an airharbor for any purposes other than those for which it has been licensed.
(d) The onus of proving the existence of any authority or license shall be upon the person charged.

25. No water-craft shall cross or go upon that part of the water area forming part of any seaplane station which it is necessary to keep clear of obstruction in order that flying machines may take off and alight in safety, having regard to the wind and weather conditions at the time, and every person in charge of a water-craft is guilty of a breach of these regulations if such craft crosses or goes upon such area after reasonable warning by signal or otherwise.

26. There shall be kept at every licensed airharbor a register in which there shall be entered immediately after the alighting or taking off of an aircraft a record showing the nationality and registration marks of such aircraft, the name of the pilot and the hour of such alighting or taking off.

27. Every licensed airharbor, and all aircraft and the goods therein shall be open to the inspection of any customs or immigration officer or any officer of or other person authorized by the Air Board, but no building used exclusively for purposes relating to the construction of aircraft or aircraft equipment shall be subject to inspection except upon the special written order of the Chairman or Vice-Chairman of the Air Board.

28. It shall be a condition of every license to any airharbor that in case the Governor-in-Council declares that a national emergency exists or is immediately apprehended, the owner of such airharbor shall comply with such directions, if any, with respect to the use of the airharbor as may be given by the Air Board or an officer of the Canadian Air Force, subject only to the payment of such compensation as may be provided by law.

29. At every licensed airharbor the direction of the wind shall be clearly indicated by one or more of the recognized methods, e.g., alighting tee, conical streamer, smudge fire, etc.

30. At every licensed airdrome and seaplane station there shall by day be a flag hoisted in a prominent position which shall indicate that if a flying machine about to alight finds it necessary to make a circuit or partial circuit such a circuit shall be left-handed (anti-clockwise) or right-handed (clockwise) according to the color of the flag. A white flag shall indicate a right-hand circuit, i.e., that the flag is kept to the right side or side which carries the green light of the aircraft, and a red flag shall indicate a left hand circuit, i.e., that the red is kept to the left side or side which carries the red light of the aircraft.

31. At every airdrome and seaplane station licensed for use by the public at night there shall at night be exhibited a red light to indicate a left-hand circuit or a green light to indicate a right-hand circuit.

32. Every licensed airdrome shall be considered to consist of three zones when looking up wind. The right-hand zone shall be the taking-off zone and the left-hand shall be the alighting zone. Between these two there shall be a neutral zone. If the center of the airdrome is marked, the taking off and alighting zones shall commence fifty yards to the right and left respectively of the center of such mark.

The word "airharbor" as used in Canadian Air Regulations applies to airdromes for heavier and lighter-than-air craft and seaplane stations. In referring to the accompanying table of ground markings the columns should be read from 1 to 5, inclusive, from left to right; and the rows from *a* to *f*, inclusive, from top to bottom. Thus for example, a commercial airharbor under 300 yd. would be marked by the symbol shown in 1,*e*.

Alberta

Lake Minnewanka, Alta. Commercial seaplane station. Situated 7 miles N.N.W. of Banff, Alta.; and 3 miles W. of Bankhead, Alta. Latitude 51 deg. 15 min.; longitude 115 deg. 25 min. Altitude 4800 ft. above sea level. Local magnetic variation 26 deg. 0 min. E of N. Maximum dimensions for landing—1000 yds. x 5 miles. Licensed for use by day only and marked with an equilateral triangle, each side of which is 3 ft. wide and 25 ft. long (inside measurement), thus: 5,e.

Telephone—Bankhead line, ring one long and two shorts. Water and fuel supply. Facilities for repairs—poor. No machine accommodation. Available communication to City of Banff—taxis and motor buses. Good gravel road.

Licensee—A. W. Faulkner, Box 84, Banff, Alta.

License No. 45. Issued 27-6-21.

Bowness Park, Alta. Commercial airharbor. Situated 6 miles west of Calgary, Alta. Latitude 51 deg. 06 min.; longitude 114 deg. 13 min. Altitude 3765 ft. above sea level. Local magnetic variation—25 deg. E of N. Maximum dimensions for landing—300 yds. square. Licensed for use by day only and marked with a triangle divided by a cross into four approximately equal parts, thus: 1.e.

Directional wind indicator on hangar; telephone number 3505. Water and fuel supply. Facilities for minor repairs only. Accommodation for two light machines. Available communication to the City of Calgary—electric railways, adjoining airdrome. Dirt and asphalt road.

Licensee—McCall-Hanrahan Aero Service, 515 Grain Exchange Bldg., Calgary, Alta.

License No. 43. Issued 2-6-21.

High River, Alta. Commercial Airharbor. Situated 2½ miles N.E. of town of High River, Alta. Latitude 50 deg. 36 min.; longitude 113 deg. 51 min. Local magnetic variation

24 deg. 2 min. E of N. Altitude 3394 ft. above sea level. Maximum dimensions for landing 600 x 800 yards. Licensed for use by day only and marked with a triangle with a circular dot in the center, thus: 4,e.

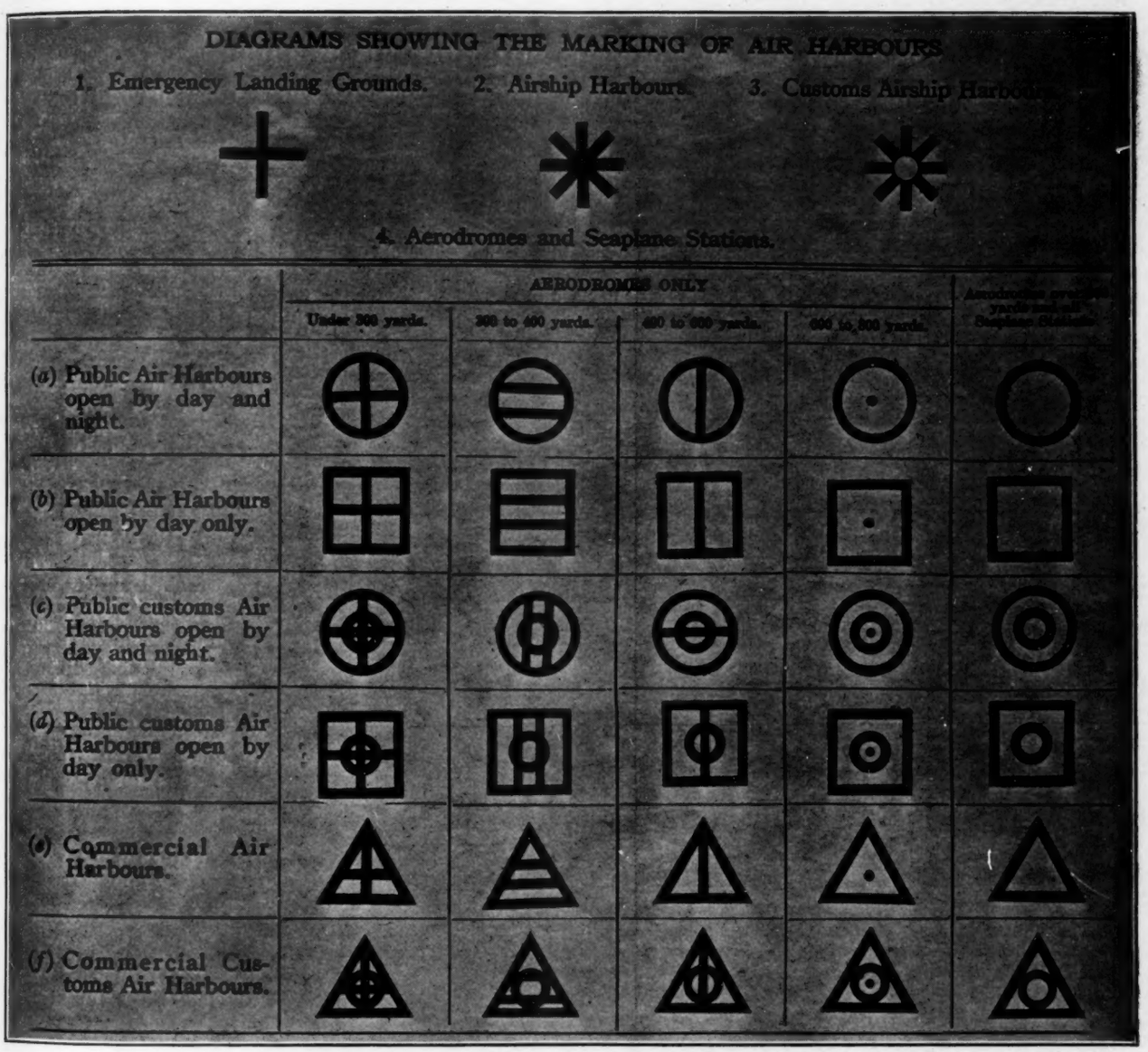
Directional wind indicator on pole near hangar. Telephone number High River 187. Telegraph and telegraphic address—Air Board Station, High River, Alta. Water and fuel supply. Repair facilities for D.H-4's and Rolls-Royce engines. Machine accommodation and a handling party stationed on the airdrome. Available communication to the town of High River—Motor transport, graded dirt roads.

Licensee—The Air Board, Ottawa, Ont.

License No. 41. Issued 7-5-21.

Hanna, Alta. Commercial airharbor. Situated ¾ miles S.E. of town of Hanna, Alta. Latitude 51 deg. 38 min.; longitude 111 deg. 56 min. Altitude 2677 ft. above sea level. Local magnetic variation 24 deg. 05 min. E. of N. Maximum dimensions for landing—under 300 yds. Licensed for use by day only and marked with a triangle divided by a cross into four approximately equal parts, thus: 1,e.

Directional wind indicator on hangar. Telephone connection. Telegraph and telegraphic address—Holbrook & McLeod. Hanna, Alta. Water and fuel supply. Facilities for minor repairs to Curtiss J.N.-4's. Accommodation for one machine. Available communication to town of Hanna—motor transport, good roads.


DIAGRAMS SHOWING THE MARKING OF AIR HARBOURS
1. Emergency Landing Grounds.
2. Airship Harbours.
3. Customs Airship Harbours.
4. Aerodromes and Seaplane Stations.
AERODROMES ONLY
Under 300 yards.
300 to 400 yards.
400 to 600 yards.
600 to 800 yards.
(a) Public Air Harbours open by day and night.
(b) Public Air Harbours open by day only.
(c) Public customs Air Harbours open by day and night.
(d) Public customs Air Harbours open by day only.
(e) Commercial Air Harbours.
(f) Commercial Customs Air Harbours.

Lethbridge, Alta. Commercial airharbor. Situated at Lethbridge Exhibition Grounds, 2 miles east of the City of Lethbridge. Maximum dimensions for landing—600 x 800 yds. Licensed for use by day only and marked with a triangle containing a circular dot in the center, thus: 4,e.

Directional wind indicator on hangar. Telephone connection. Telegraph and telegraphic address—Lethbridge Aircraft Co., Ltd., Lethbridge, Alta. Water and fuel supply. Facilities for minor repairs only. Hangar accommodation. Available communication to the City of Lethbridge—motor transport, good roads, electric railway ½ mile W. of airdrome.

Licensee—Lethbridge Aircraft Co., Ltd., Lethbridge, Alta.

License No. 35. Issued 28-8-20.

Licensee—Holbrook & McLeod, Hanna, Alta.

License No. 7. Issued 10-5-20.

Edmonton, Alta. Commercial airharbor. Situated on St. Albert trail 3½ miles N.W. of Edmonton, P. O. Latitude 53 deg. 35 min.; longitude 113 deg. 33 min. Altitude 2215 ft. above sea level. Local magnetic variation 27 deg. 0 min. E of N. Maximum dimensions for landing—under 300 yds. Licensed for use by day only and marked with a triangle divided by a cross into four approximately equal parts, thus: 1,e.

Directional wind indicator on hangar. Telegraph and telegraphic address—May-Gorman Aeroplanes Ltd., 10327 99th Ave., Edmonton, Alta. Telephone connection. Water and fuel supply. Facilities for minor repairs only. Hangar ac-

commodation. Available communication to City of Edmonton —motor transport, electric railway ½ mile S.E. of airdrome, good roads.

Licensee—May-Gorman Aeroplanes, Ltd., 10327 99th Ave., Edmonton, Alta.

License No. 5. Issued 7-5-20.

British Columbia

Burrard Inlet, Vancouver, B. C. Commercial seaplane station. Situated at the foot of Burrard Street on Burrard Inlet, Vancouver Harbor. Latitude 49 deg. 16 min.; longitude 123 deg. 06 min. Alttiude—sea level. Local magnetic variation 25 deg. 0 min. E of N. Maximum dimensions for landing approximately two square miles. Licensed for use by day only and marked with an equilateral triangle, each side of which is 3 ft. wide and 25 ft. long (inside measurement), thus: 5,e.

Directional wind indicator—conical streamer on hangar. Water supply, facilities for overhauling Curtiss OX5 engines, fuel supply and accommodation for one machine.

Available communication to City of Vancouver—electric railway and paved roads.

Licensee—The Aircraft Manufacturers Ltd., 1004 Standard Bank Building, Vancouver, B. C.

License No. 44. Issued 1-6-21.

English Bay, Vancouver, B. C. Seaplane station. Situated at Jericho Beach near Vancouver. Latitude 49 deg. 16 min.; longitude 123 deg. 17 min. Altitude—sea level. Local magnetic variation 25 deg. 0 min. E. of N. Maximum dimensions for landing—over 4 miles square. Licensed for use by day only and marked with a triangle, thus: 5,e.

Directional wind indicator on boat house. Telephone Bayview 4228. Telegraph and telegraphic address—Air Board Station, Jericho Beach, Vancouver, B. C. Water and fuel supply. Repair facilities. Hangar accommodation and a handling party on the station. Available communication to the City of Vancouver—motor transport, motor boats, paved roads.

Licensee—The Air Board, Ottawa, Ont.

License No. 31. Issued 4-8-20.

Comox, B. C. Commercial seaplane station. Situated ½ mile S.W. of the town of Comox, B. C. Latitude 49 deg. 39 min.; longitude 124 deg. 54 min. Altitude—sea level. Local magnetic variation 25 deg. 07 min. E of N. Maximum dimensions for landing—over 800 yds. Licensed for use by day only and marked with an equilateral triangle each side of which is 3 ft. wide and 25 ft. long, thus: 5,e.

No telephone connection. Water and fuel supply. Facilities for minor repairs to Curtiss J.N.-4 machines. Mooring accommodation. Available communication to the town of Comox—motor lorry, gravel road, three miles to nearest railway or shipping port.

Licensee—Vancouver Island Aerial Transport Co.

License No. 25. Issued 12-7-20.

Manitoba

Victoria Beach, Man. Commercial seaplane station. Situated at Victoria Harbor, Man. Latitude 50 deg. 42 min.; longitude 96 deg. 33 min. Altitude 715 ft. above sea level. Local magnetic variation 11 deg. 05 min. E of N. Maximum dimensions for landing—over 800 yds. Licensed for use by day only and marked with an equilateral triangle each side of which is 3 ft. wide and 25 ft. long, thus: 5,e.

Telegraph and telegraphic address—Air Board Station, Victoria Beach, Man. Water and fuel supply. Facilities for repair to F.3 and H.S.2.L flying boats. Slip-way for beaching flying boats. Available communication to town of Victoria Beach—motor boat and good roads.

Licensee—The Air Board, Ottawa, Ont.

License No. 47. Issued 20-8-21.

Brandon, Man. Commercial Airharbor. Situated ½ mile west of City of Brandon on Victoria Avenue. Latitude 49 deg. 50 min.; longitude 99 deg. 58 min. Altitude 1204 ft. above sea level. Local magnetic variation 15 deg. 7 min. E of N. Maximum dimensions for landing 400 x 600 yards. Licensed for use by day only and marked with a triangle divided by a vertical line, thus: 3,e.

Directional wind indicator on hangar. Telephone number 2301. Telegraph and telegraphic address—Brandon Aerial Services, Prince Edward Hotel, Brandon, Man. Facilities for top overhauls only. Water and fuel supply. Accommodation for one or two machines and a handling party stationed on the airdrome. Available communication to the City of Brandon—electric railway, motor transport and good roads.

Licensee—Brandon Aerial Services, Prince Edward Hotel, Brandon, Man.

License No. 23. Issued 26-6-20.

Virden, Manitoba. Customs Airharbor, (Lat. 49 deg. 50 min. N; Long. 100 deg. 50 min. W) about 1½ miles South of the Town of Virden, Manitoba. Altitude 1450 ft. above sea level. Dimensions 800 yards N & S by 800 yards E & W. Licensed for use by day only and marked with a square and enclosed circle, thus: 5,d.

Customs personnel on duty only when notified at the Custom Sub-Collector's Office. Directional wind indicator in North Western corner. Telephone connection fuel and water supply. Facilities only for minor repairs. No hangar accommodation. Road communication good. Rail communication C.P.R.

Licensee: Town of Virden.

License No. 17. Issued 29-5-20.

Winnipeg, Man. Commercial Airharbor. Situated 5 miles in a westerly direction from corner Portage Ave. and Main Street, Winnipeg. Latitude 49 deg. 53 min.; longitude 97 deg. 18 min. Altitude 776 ft. above sea level. Local magnetic variation 13 deg. 0 min. E. of N. Maximum dimensions for landing 500 x 300 yards. Licensed for use by day only and marked with a triangle divided by two lines forming a cross into four approximately equal parts, thus: 1,e.

Directional wind indicator on pole near hangar. Telephone N. 6415. Telegraph and telegraphic address Canadian Aircraft Co., Ltd., 43 Aikens Building, Winnipeg, Man. Water and fuel supply. Facilities for repairs. Accommodation for two machines. Available communication to City of Winnipeg —electric railway, motor transport, paved roads.

Licensee—Canadian Aircraft Co., Ltd., 43 Aikens Building, Winnipeg, Man.

License No. 12. Issued 18-5-20.

Winnipeg, Man. (*River Park*) Commercial airharbor. Situated at River Park, western edge of the City of Winnipeg. Latitude 49 deg. 51 min.; longitude 97 deg. 08 min. Altitude 760 ft. above sea level. Local magnetic variation 12 deg. 7 min. E of N. Maximum dimensions for landing—under 300 yds. Licensed for use by day only and marked with a triangle divided by two straight lines forming a cross into four approximately equal parts, thus: 1,e.

Directional wind indicator on hangar. Telephone connection. Telegraph and telegraphic address—Winnipeg Airco Ltd., 408 Confederation Life Bldg., Winnipeg, Man. Water and fuel supply. Facilities for minor repairs only. Hangar accommodation. Available communication to City of Winnipeg—electric railway, motor transport, paved roads.

Licensee—Winnipeg Airco Ltd., 408 Confederation Life Bldg., Winnipeg, Man.

License No. 11 Issued 18-5-20.

New Brunswick

Fredricton, N. B., Customs Airharbor (Seaplane) (Lat. 450 deg. 80 min. N. Long. 66 deg. 39 min W) situated on St. John River—on west side of Fredericton Highway Bridge. Altitude 18 feet above sea level—dimensions—over 800 yards N & S—over 800 yards E & W—licensed for use by day only and marked thus: 5,d.

Customs personnel on duty when notified at the Collector of Customs' Office, Fredericton. Telephone, gasoline, oil and water supplies, power launch, 2 mooring buoys available. A wind indicator is placed on the south shore of the St. John River, approximately 600 yards west of Fredericton highway bridge.

Communication—Road and railway—CNR and CPR, Station, half a mile south of airharbor.

Licensee—City of Fredericton.

License No. 37. Issued 16-11-20.

(To be continued)

Parachutes *

By Major T. Orde Lees

When the airplane came into being ten years ago the parachute had no place in the practical politics of aeronautics. The extensive use of observation balloons, throughout the war, brought the life-saving capabilities of the parachute to the front. In pre-war days the parachute was regarded almost exclusively as a medium for daring displays. Public interest has been aroused by the fact that the lives of over 800 men were saved from balloons by parachute and many more might have been saved from airplanes by the provision of this simple appliance.

For the last six months of the war the Germans were using a comparatively crude type of parachute in nearly all their airplanes. This equipment was entirely optional. Nine out of ten pilots elected to carry them. According to the best information I can get, of the pilots who had occasion to use them, nine out of ten saved their lives.

I was in Berlin in November last and had long personal talks with five independent German pilots. Making every allowance for patriotic exaggeration on the part of my German informants, one must concede, from the reports of our own airmen, that at least five out of ten German pilots who resorted to their parachutes were saved. If only one in ten had been saved, the carrying of parachutes becomes both a humane and a man-economizing proposition.

Influence on Airplane Performance

One of the biggest objections to the fitting of parachutes—their effect on that elusive quality of a machine termed "the performance"—seems to have been quite disregarded by the Germans. All war fliers appreciated the critical value of superiority of speed and climb. The weight of a 28 lb. parachute makes an appreciable difference, two parachutes a material difference on a DH-4 for instance. One parachute reduces the speed by 1½ per cent, two by nearly 2 per cent. The climb is reduced 50 ft. and 75 ft. per minute respectively. A large passenger machine fully equipped would probably be less affected.

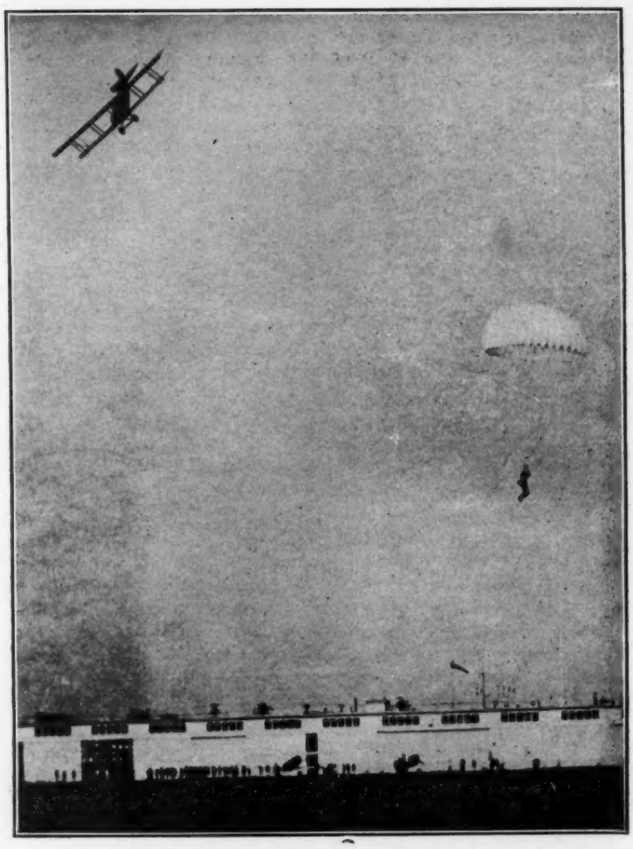
The fear that aviators might be tempted to resort to their parachutes prematurely when, by sticking to their airplane, they might succeed in saving it seems to have no foundation in fact among the German fliers. From what I know of British fliers I think it would have less among them. Still, the suggestion has been advanced as an argument against fitting parachutes.

During the war I estimated that about 200 British pilots were seen to jump without parachutes from their burning machines at high altitudes rather than be roasted to death in mid-air. All were killed. Nearly all would have been saved if they had had parachutes, because they all proved that they were able to get out and jump and because a burning machine can be kept on an even keel until the last minute.

It has often been said that parachutes will act with certainty only when the machine is on an even keel and conversely that when the machine is on an even keel they would never be required. Well, there are about 200 cases where the doomed aviators demonstrated that they could make good their exits. Everyone in the Air Force knows of several cases of this happening, if they have not actually seen it with their own eyes. Two hundred is merely an estimate, but I can quote chapter and verse for three cases, two in war and one in peace, which must convince the most skeptical that the provision of parachutes would have saved the lives of two men whose great experience and ability in the air made them of real value to their respective countries.

The first is Major Lufberry—the American fighting Ace. Enemy action ignited his machine at 2,500 ft. For 2,000 ft. he struggled to extinguish the flames and keep the machine under control. At 500 ft., unable to withstand the torturing heat any longer, he was seen deliberately to get out of his machine and jump to earth.

Lieutenant Berkeley, of the Coldstream Guards, was one of the very few British pilots who had ever made a parachute descent from an airplane. He did so in October, 1918. Three months later, in my presence, he collided in the air. The other machine, a single-seater, got away, and made a lucky landing without an under-carriage. Lieutenant Berkeley had a passenger. If both had had parachutes, both could easily have used them as the collision happened at over 2,000 ft. The right



MAJ. ORDE LEES JUMPING WITH A PARACHUTE

wing of the two-seater was badly broken. The machine was out of control all the way down, swerving this way and that but, for appreciable periods, righting itself and giving ample opportunities for the aviators to use parachutes. They had none. The pilot was killed, the passenger survived in spite of serious injuries. On this occasion fire did not break out on impact with the ground, as it so often does.

The third case is that of Peter Leigh. His machine burst into flames at only 200 ft. above the houses at Finchley. He at once got out, apparently misjudged his height, and attempting to use his coat as a parachute, jumped. Successful parachute jumps have been made from less than this height. Peter Leigh clearly showed his ability to use a parachute even at a low height. He was killed.

To mention but a few among famous aviators who met their deaths in accidents where parachutes might have spared them, we have Lieutenant Warnford, V.C., Captain Ball, V.C., Pégoud, Cody, Professor Hopkinson and Major Gooden, the popular Farnborough test pilot, who had made a number of parachute descents from balloons before the war. He was killed by a wing breaking off in mid-air.

While parachutes could have been used in thousands of cases during and since the war, it must be admitted that the

* Lecture delivered before the Royal Aeronautical Society.

majority of air casualties are due to accidents happening on or near the ground when taking-off or landing, collisions with terrestrial objects in fogs, or through engine failures and by stalling. There have been a great many accidents where no type of parachute at present on the market could have availed the aviators. No existing parachute would have saved Sir John Alcock or Major McCudden, V.C., for example.

It is quite a mistake to suppose that parachutes cannot be used with the machine in any position. They can be so used. The Germans so used them. What is good for military machines in the matter of life-saving equipment should surely be as useful on passenger aircraft.

Parchutes on Civil Aircraft

So far parachutes have not been made compulsory on any form of civilian aircraft. Until compelled by legislation aerial transport companies are not likely to reduce their useful carrying capacity by the voluntary provision of parachutes. Commercial always over-ride humane considerations until Parliament acts. If aerial transportation could be carried out at about half the cost of railway transport, parachutes would, no doubt, be fitted at once as a commendable refinement to every civil machine, if only on account of the attractive reduction in personal premiums already offered by certain insurance companies where parachutes form part of the equipment.

As soon as insurance companies are convinced that parachutes are a reliable means of life-saving, reduction of premiums should go far toward cost of parachutes. "Wheels and Wings" already quotes a substantial rebate if parachutes are fitted.

At present, seeking for plausible objection, but possibly prompted by motives of economy, it is not infrequently argued that the provision of parachutes would unduly emphasize the potential danger of flying, scare the public and reduce the passenger list—in short, the dividends.

The argument that, in large machines, passengers could not get out in time is as much of an argument against the use of large machines as it is against parachutes, but in any case, the statement is one that cannot be substantiated in the present state of our meager knowledge on the subject. The other argument that "we will wait and see how they answer on military machines before adopting them on civil aircraft" is, like most wait and see arguments, fatuous because, in the first place, the price of procrastination may be hundreds of lives and much public confidence lost where parachutes could have prevented these catastrophes. Secondly, there is no need to wait and see, for the Germans have already conclusively demonstrated the practicability of the airplane parachute.

If we wait and see much longer we shall wait long enough to see an aerial "Titanic" disaster. The public, who know nothing of aviation and care less at present, will suddenly wake up to the fact that something should be done to make it safer than it is; through the press they will learn of the parachute and clamor for it.

The recent disaster of the Centaur triplane at Hayes, where all six occupants were killed, is a clear case of an accident to a multi-passenger machine where all might have been saved by parachutes. The death at Huntingdon of Captain Sadler, who had often dropped parachutists from his machine, is another recent case where parachutes were urgently needed.

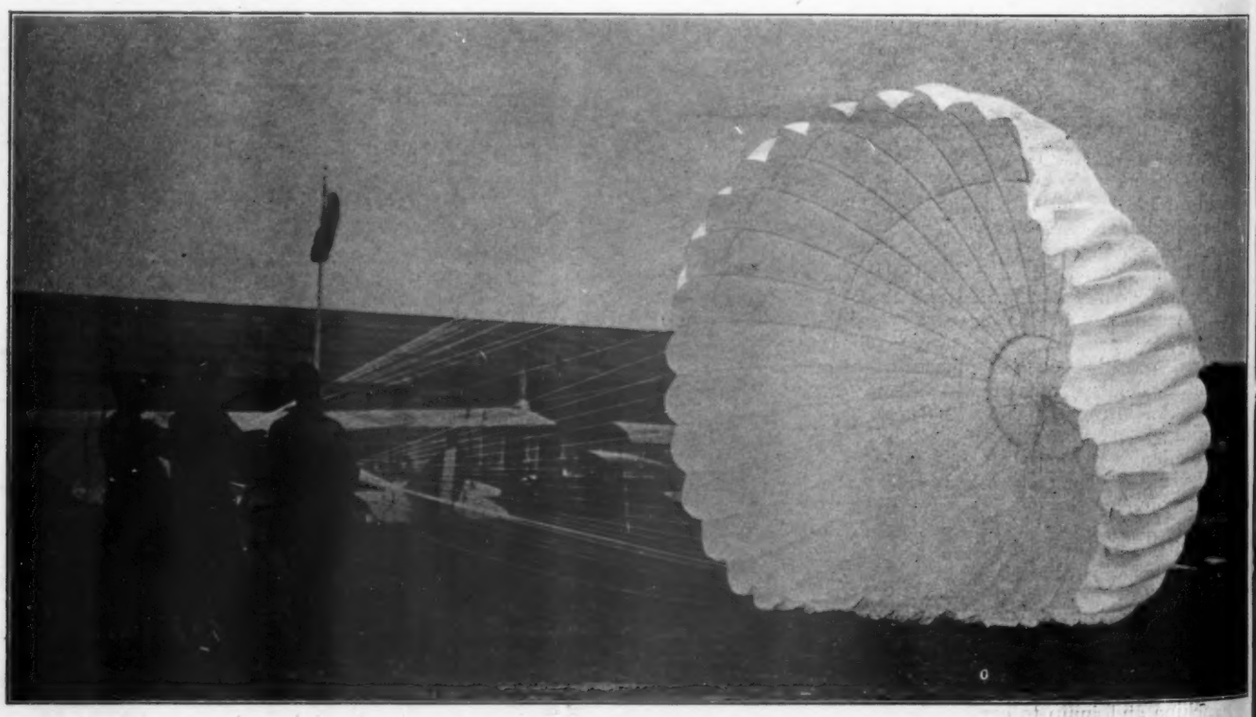
The Handley-Page crash at Golder's Green, a week before Christmas, was a case where the ordinary types of parachutes would have been useless, but no argument against fitting them, while the loss of another Handley Page in the Irish Sea during the same week was a potent argument for the policy of equipping trans-oceanic machines with parachutes-cum-life-belts.

The Problem on Large Airplanes

The problem of getting all of the occupants out of multi-passenger machines is a very difficult one, but is receiving adequate attention. Probably the most effective solution at present beyond the paper stage is the individual parachute carried on the passenger's back, but attempts to solve the difficult problem of removing the passengers and cabin *en bloc* seem hopeful.

One inventor, regardless of centers of gravity and pressure, seeks to relegate the passengers to the tail of the machine, which member, like that of certain snakes, can be detached at will and be left behind suspended in the air by a great parachute while the engine, wings, and, presumably, the pilot continue their headlong career earthwards.

This contraption reminds us somewhat of the desperate expedients of inventors to produce a folding bicycle. The patent records, especially those of the American office, abound with crude ideas for salving a part of the entire airplane by means of a parachute shown generally in the accompanying drawings as of hopelessly inadequate size. Strange to say, of the three or four hundred patents I have examined the vast majority



TESTING A PARACHUTE'S CORDS

show parachutes so small that the speed of descent would be fatal, and with a single exception, not one of all those patents shows the parachute in flight correctly shaped.

In both practice and theory the suspension cords of a parachute must be at a tangent to the surface of the umbrella portion at their points of attachment to its periphery while the parachute is in flight. One would have thought this was obvious, but in not a single drawing I have ever seen has it been shown absolutely correct, which only shows how little of the theory the people who rush into patents really know. This may also account for the enormous number of inadequate parachutes proposed, not to mention the ludicrous attempts to combine parachutes with the aviator's clothing.

It would be very convenient if a parachute the size of an umbrella would reduce one's downward speed to safe limits. Unfortunately, the minimum size of parachute to produce a landing at safe speed under any conditions seems to be about 28 ft. diameter, which accounts for one of the principal difficulties in the parachute problem.

In the American patent files there are at least a dozen showing a parachute about three feet across for saving a man. Equally quaint are some of the parachutes shown as salving the whole airplane. These vary in the specifications from 10 to 20 ft. in diameter and are invariably shown vertically above the center of gravity of the machine, with the latter horizontal just as if it had no forward speed. To salve a super Handley a parachute the size of Trafalgar Square weighing a ton or more, would be required.

A Historical Retrospect

The first authentic reference to parachutes as they are known today is to be found in the aeronautical sketch book of Leonardo da Vinci (A.D. 1500). His prevision was extraordinary. He outlines a parachute almost identical in size and construction with those used for man-saving during the war.

He does not seem to have known quite how it might be used, but as flying was always regarded is inherently dangerous until it was actually achieved in 1908, early investigators often thought more of the cure than the prevention of accidents and Da Vinci was an inventor of flying machines—orthopters.

As to actual descents, there are perfectly credited records of such having been made from a tower in the 18th century by Fausto Veranzio, using a cloth stretched on a rectangular framework. Another experimenter, Gaspard Le Norman, undoubtedly made descents with something of the same kind in 1783. Montgolfier also made a couple of descents.

In 1793 Blanchard, the well known pioneer balloonist, after trying experiments with his dog, himself made a drop at Basle. He seems to have blundered in some way, probably losing his head and dropping almost as soon as the balloon commenced to rise, so that the parachute was not fully open. Anyhow Blanchard broke one of his legs.

Garnerin, Blanchard's rival, followed suit immediately and with greater success. He made many drops in various countries and one of 8,000 ft. in London, landing at St. Pancras.

His sister was the first woman to make parachute descents. She made about 40. In 1804 Kuparento, a Pole, succeeded in saving his life by using a parachute. A good many aeronauts lost their lives by neglecting to equip their balloons with parachutes.

Blanchard and Garnerin had several emulators. The parachute established itself as a medium for sensational performances rather than as an aerial life-saving appliance. The reverse is the case today.

Except for the universal adoption of the vent hole suggested by the great French astronomer Lalande, as a palliative to stop the violent swinging to which the early parachutes were prone, nothing of importance occurred until 1837 when Mr. Cocking killed himself by testing his huge inverted cone type of parachute. It weighed over 400 lbs. and was forty feet in diameter at the top and eight feet at the bottom. The periphery was stiffened with a tubular tin hoop, the collapse of which, a few seconds after the start, was responsible for the fatality.

In any case so monstrous a machine was quite unpractical except as a spectacular apparatus. It acted as a drag on the Great Nassau balloon when it ascended. The sudden release of so great a weight caused the balloon to bound up many thousands of feet. The discharge of gas from the neck nearly asphyxiated the occupants.

Cocking's misadventure, although without practical, other than negative value, is the most interesting parachute experiment as it was made with a theoretically efficient type. The collapse was due merely to bad workmanship.

Wise, a really splendid American aeronaut, demonstrated the possibility of such parachutes, not with himself but with his dog, as was the custom among early aeronauts. Wise was not, however, lacking in daring for he invented the thrilling stunt of ripping his balloon in mid-air and allowing it to act as a parachute by reason of the envelope collapsing parachute-wise into the net. This can practically always be relied upon to occur when a spherical balloon bursts, provided there is sufficient height and that the neck line is not secured, or if secured can be untied.

Close-up of a Parachute in Use

When his balloon burst at 1,000 ft. shortly after an ascent from Vauxhall Gardens in 1847, Green, a celebrated aeronaut, saved the lives of his four fellow passengers by his presence of mind in untying the neck line.

Captain Dale, at the Crystal Palace in 1892, was less successful, but then his balloon was at only 600 ft.; some of you will remember the event. The two other occupants, one his son, survived.

A somewhat similar but safer expedient is to provide the balloon with a valance around its middle and to suspend the car from the periphery of this flounce. This is known as an equatorial parachute. It is a very old idea, having been suggested by Bramicki in 1867, while old cuts show it on Blanchard's balloon in 1784. Why such a simple safeguard has not found greater favor I do not know, unless it is that bursting is considered too rare to need a remedy.

(To be continued)

"Who's Who in American Aeronautics"

(Copyright, 1921, by The Gardner, Moffat Co., Inc.)

Every week, AVIATION AND AIRCRAFT JOURNAL prints the biographical sketch of men who are prominent in American Aeronautics. These sketches will be published later in pamphlet form. As so many of the officers change their stations often, it is believed that a semi-annual issue will be necessary. In compilations of this character many errors and ommissions occur. It will be appreciated of corrections are sent to "Who's Who" Editor.

Howard Douglas Smith

SMITH, HOWARD DOUGLAS, Student; born, Council Bluffs, Iowa, Feb. 13, 1897; son of Alex Marquardt (Step-Father) and Ella Marquardt.
Educated: Marshalltown public schools; University of Kansas.
Aeronautical Activities: Aerial Observer, Post Field, Fort Sill, Okla., Dec. 6, 1918 to Feb. 11, 1919; primary pilot's school, Park Field, Tenn., Feb. 11 to March 15, 1919; pursuit school, Carlstrom Field, Fla., March 15, 1919 to May 14, 1919; flying time while in the service, 250 hr.
Flying Rating: Reserve Military Aviator and Airplane Observer.
War Service: U. S. Air Service, Feb. 12, 1918 to May 14, 1919; school of military aeronautics, Austin, Tex.; school of fire for field artillery, Fort Sill, Okla.; school of aerial observation, Post Field, Fort Sill, Okla.; primary school for pilots, Park Field, Memphis, Tenn.; pursuit school, Carlstrom Field, Arcadia, Fla.
Member: Allied Fliers Club, Oakland, Calif.
Present Occupation: Student.
Address: 350 North Green St., Wichita, Kans.

Everett Laing Thompson, Jr.

THOMPSON, EVERETT LAING, Jr., Engineer; born, Brooklyn, N. Y., July 11, 1893; son of Everett Laing Thompson, Sr. and Minnie A. Thompson; married, Fritzi Dorothy Euler, Sept. 24, 1918.
Educated: Public schools of Brooklyn, N. Y. and Dover, N. J.; 1916, Stevens Inst. of Tech.
Professional: Engineer, Automatic Sprinkler Co. of America.
Aeronautical Activities: Enlisted, Sept. 1917 and after instruction in Ground School and Flying Station (Bay Shore, L. I. and Pensacola, Fla.) was commissioned Ensign as Flight Instructor until end of war.
Flying Rating: Ensign U.S.N.R.F.; Naval Aviator No. 1182.
War Service: Flight Instructor, U. S. Naval Air Station, Pensacola, Fla.
Member: American Legion; Aero Club of America.
Present Occupation: Engineer.
Address: 123 William St., New York, N. Y.; home, 382 Park Ave., East Orange, N. J.

Jesse Daniel McClure

McCLURE, JESSE DANIEL, Automobile Business; born, Monticello, Ill., June 8, 1889; son of Daniel K. McClure and Mary McClure.
Educated: Monticello High School.
Professional: Packard Automobile Co., 1908-1911; operated garage from 1911-1917.
Aeronautical Activities: Was in charge of motor repair and machine shop at Chanute Field; flew in Chanute Field ship No. 17 in trans-continental race; cadet course at Carlstrom Field, Arcadia, Fla. taking flying training and aerial gunnery, was also motor instructor in all classes at this school.
Flying Rating: Aviators Certificate, Aero Club of America.
War Service: March 21, 1917 to May 29, 1919 with 108 Engineers, overseas.
Present Occupation: Proprietor of Buick Garage.
Address: South Market St.,; home, W. Williams St., Monticello, Ill.

Junius Wallace Jones

JONES, JUNIUS WALLACE, Major, Air Service; born, Jackson, La., April 3, 1890; son of Dr. P. H. Jones and Annabelle (Smith) Jones; married, Mary Beirne Harmon, Dec. 29, 1914.
Educated: 1907, Bingham School; 1907-1908, Louisiana State University; U. S. Military Academy, 1909-1913.
Professional: Served with Coast Artillery Corps from Sept. 1913 to June 1916; instructor, U. S. Military Academy from Sept. 1916 to June 1919; A. E. F., June to Nov. 1919.
Aeronautical Activities: Graduate, Air Service Pilot Training School, Carlstrom Field.
Member: Army Polo Association.
Present Occupation: Major, Air Service.
Address: Adjutant General, Washington, D. C.; home, 736 Convention St., Baton Rouge, La.

Frank Pearce Whitehurst

WHITEHURST, FRANK PEARCE, Farmer; born, Princess Anne Co., Va., April 22, 1890; son of W. L. Whitehurst and Henrietta (Woodhouse) Whitehurst; married, Frances G. Cherry, May 9, 1921.
Educated: Public and high schools; Eastman College.
Professional: Farmer, 10 years; bank clerk, 2 years.
Aeronautical Activities: Princeton S.M.A., Dec. 15 to Feb. 23, 1918; training at Dallas, Tex., San Antonio, Tex., and Garden City, 1918.
Flying Rating: Reserve Military Aviator.
War Service: U. S. Army, 2nd Lieut., Oct. 1917 to Dec. 1918.
Member: Aero Club of America.
Present Occupation: Farmer.
Address: R. F. D. No. 5, Box 117, Princess Ann Co., Va.

Willis M. Hawley

HAWLEY, WILLIS M., Salesman; born, Chautauqua, N. Y., July 7, 1896; son of Lucius E. Hawley and Frances M. Hawley; married, Lillian Chandler, Nov. 22, 1919.
Educated: Public schools of Ben Avon, Pa.; three years, Carnegie Inst. of Tech.; one year, University of Southern California.
Professional: Electrical Engineer, Pittsburgh, Pa.; Elec. Construction, Los Angeles, Calif.
Aeronautical Activities: S. M. A., Berkeley, Calif., 1918; Kelly Field, Nov. 1918 to May 1919; commissioned 2nd Lieut., S. O. R. C,, May 1919.
Flying Rating: Reserve Military Aviator.
War Service: Feb. 1917 to May 1919.
Present Occupation: Salesman.
Address: 321 S. Hoover St.; home, 185 California St., Walnut Park, Los Angeles, Calif.

Martin Aloysius Powers

POWERS, MARTIN ALOYSIUS, Chemical Engineer; born, Waukesha, Wis., Nov. 13, 1892; son of John J. Powers and Bridget Ellen Powers.
Educated: Grammar school; Fond du Lac, Wis., high school; B. S. 1917, Chemical Engineering, University of Wisconsin.
Professional: Chemical investigator with the New Jersey Zinc Co., 1917 to 1918; Assistant to Supt. of Chemical and Metallurgical plant, 1919 to date.
Aeronautical Activities: Cornell University, School of Military Aeronautics; Carruthers Flying Field.
Flying Rating: Reserve Military Aviator.
War Service: Jan. 1918 to Jan. 1919.
Present Occupation: Chemical Engineer.
Address: 534 LaFayette Ave., Palmerton, Pa.

Gilbert Charles Baker

BAKER, GILBERT CHARLES, Oil Business; born, Boonville, Ind., July 10, 1898; son of Frank Baker and Carrie (Carter) Baker.
Educated: Public school and high school, Boonville, Ind.
Professional: Newspaper reporter, 1919; Oil Co., Jan. 1920 to date.
Aeronautical Activities: Student pilot, Love Field and Ellington Field.
Flying Rating: Reserve Military Aviator.
War Service: Air Service, Dec. 1917 to March 1919.
Present Occupation: Oil Business.
Address: R. F. D. No. 2, Meno, Okla.

Harry Alexander Erickson

ERICKSON, HARRY ALEXANDER, Photographer; born, Helsingbors, Finland, Aug. 16, 1884; son of Frank O. Erickson and Anna Erickson; married, Mayme Korherr, June 2, 1913.
Educated: Public and high schools.
Professional: Photographic work from 1900 to date.
Aeronautical Activities: Photographic Officer.
Flying Rating: Observer, 1917; Pilot, 1919.
War Service: Air Service, June 1917 to Jan. 1920.
Present Occupation: Photographer.
Address: Hotel Del Coronado, Coronado, Calif.; home, 420 N. 28th Street, San Diego, Calif.

Henry Horace Tufford

TUFFORD, HENRY HORACE, Tire Specialist; born, Kensal, N. D., Jan. 23, 1886; son of Alva Tufford and Elizabeth (Barnett) Tufford.
Educated: Public schools and high school; business college and extension courses.
Professional: Accountant, 1906 to 1910; tire business, 1910 to 1918.
Aeronautical Activities: 1918, assigned Chief Vulcanizing Instructor, Air Service Mechanics Schools, St. Paul; commissioned 2nd Lieut., Air Service Reserve, 1920.
War Service: Instruction only.
Books: "Tire Repairing and Vulcanizing", 1918; "Tire and Vulcanizing", 1920; "Better Tiremen", 1920; "Tire Business Answered", 1921.
Present Occupation: Supervisor of Tire Training at Dunwoody Institute, Minneapolis, Minn.
Address: Box 673; home, 333 8th St. S. E., Minneapolis, Minn.

Harry Leslie Remington

REMINGTON, HARRY LESLIE, Farmer; born, Stanberry, Mo., May 3, 1894; son of Howard Coe Remington and Martha Remington.
Educated: Public and high schools of Minot, N. D.
Aeronautical Activities: Artillery Observation School, Camp De Souge, France; Second Aviation Instruction Center, Tours, France; 2nd Corps Aero School, Chatillion sur Seine, France.
Flying Rating: Aerial Observer.
War Service: National Guard, July 1917 to March 1918 in U. S. and France; Air Service, Sept. 1918 to July 1919.
Present Occupation: Farming.
Address: Granville, N. D.

Raymond DeMott Smith

SMITH, RAYMOND DEMOTT, Student; born, Cleveland, Ohio, June 7, 1897; son of Alfred E. Smith and Gertrude Smith.
Educated: Dunham Grammar School; East High School, Cleveland, Ohio; B.S. 1921, University of Michigan.
Aeronautical Activities: Ground School, University of Illinois, Aug. 1917; sent to Call, Love, and Ellington Fields for training.
Flying Rating: Reserve Military Aviator, June 1919.
War Service: Air Service, U. S. Army, Aug. 1918 to June 1919.
Member: Aero Club, University of Michigan.
Present Occupation: Student.
Address: 604 S. State St., Ann Harbor, Mich.; home, 1836 E. 87th St., Cleveland, Ohio.

William Jefferson Davis

DAVIS, WILLIAM JEFFERSON, Lawyer; born, Virginia, March 17, 1885.
Educated: B.S., George Washington University; LL.B., Georgetown University; post graduate work, University of Virginia.
Professional: Lawyer.
War Service: Liaison officer on Staff of Maj. Gen'l. W. L. Kenly, Director of Military Aeronautics, Oct. 1918 to Jan. 1919.
Books: "Laws of the Air."
Member: Army and Navy Club (Wash.).
Present Occupation: Lawyer.
Address: 1110-1112 First Nat'l Bank Bldg., San Diego, Calif.; home, Hotel Del Coronado, Coronado, Calif.

Hugh Sears

SEARS, HUGH, Theatrical Manager; born, Vanceboro, Me., June 5, 1890; son of Andrew J. Sears and Elizabeth (Mac Donald) Sears.
Educated: High school, Danforth, Me.
Professional: Seven years with Underwriters Salvage Co. of N. Y.
Aeronautical Activities: School of Military Aeronautics, Princeton, N. J., 1917; flying training at Kelly Field, Carlstrom Field, and Ellington Field.
Flying Rating: Reserve Military Aviator.
Member: Aero Club of America.
Present Occupation: Theatrical Manager.
Address: 11 Old Broadway, New York, N. Y.

Duralumin, Its Characteristics and Use *

By William B. Stout

Duralumin, or 'Dural" as it is called, is a copper aluminum alloy one-third the weight of cold rolled steel and yet of the same approximate strength characteristics. It can be heat treated to higher physical properties, but such are its peculiarities that the effect of this heat treatment is not apparent for at least an hour after it has been done. The strength and lightness of the metal together with its heat treatment possibilities make it available for certain kinds of manufacture at a consequent lower production cost.

The metal received its first development in the aircraft industry abroad, particularly by the Zeppelin firm in Germany, but later research in this country has brought it to a stage far in advance of the German product. The application of the metal to the construction of all types of aircraft has made possible its development for other kinds of manufacture.

Duralumin can be rolled into sheets or forged by hand press or power hammer. It can be cast, welded, and soldered while rivets of the same material used with it show new production possibilities on account of the peculiarities of the heat treatment results. Connecting rods have been made of it in which the metal itself, without any anti-friction material, has been used for wearing surfaces. These connecting rods have been used successfully in both aircraft and automobile engines. Worm gears made of it have been used successfully against steel pinions in heavy truck service. Timing gears made of it show new possibilities of wear and quietness.

The greatest use of the metal, however, has been in structural shapes for light construction. The metal itself costs about five times as much as cold rolled steel, but for production work only one third the weight of duralumin is required to obtain the same strength result as is obtained with steel. At the same time there is a saving in material and labor tool cost because duralumin is easier to work than steel.

The work which has been followed has been almost entirely along the line of reducing the weight of fairly large aircraft structures. The saving of a pound in an airplane structure means the addition of a pound of fuel or pay load, so that in aircraft more than anywhere else the saving of weight is vital. Strength is, however, no less vital as an airplane in flight is subject to stresses greater than those imposed on an automobile in road transport.

Structures are now being built of duralumin whose strength figures far exceed those of the same type of wooden structure and yet which are lighter than the latter. The entire secret of the weight result is of course not due to the metal alone, but it is safe to say that the result could not have been attained with our present knowledge of other materials.

Sheet steel is sometimes preferred to duraluumin for experimental aircraft work because it possesses greater tensile strength weight for weight than duralumin. This is quite so, but the problem of strength in a structure—particularly an airplane structure—is not ordinarily one of tensile strength, but rather one of compressive strength. Weight for weight duralumin has about three times the thickness of cold-rolled steel, and about five or six times that of alloy steels of high tensile strength. The rigidity of a sheet of metal is dependent on its thickness and while duralumin is a much more flexible material than steel thickness for thickness its lighter weight makes possible an increase in thickness and a consequent greater rigidity than steel weight for weight. For example there has been produced recently a rolled section designed for a maximum column strength and yet of such shape as to meet production requirements. This section is 0.035 in. in thickness and a 19 in. column of it, capable of supporting 4 tons plus, weighs but 7½ oz. If this column had been made in a high alloy steel its thickness would have been, as far as tensile requirements go, about 0.009 in. which would result in a fragility too great to be trustworthy in a structure because of the lack of rigidity which results in such a thin wall.

Duralumin, in appearance, is not unlike aluminum except that it will take a very high polish, and that when it is polished the glint of the copper in the alloy may be detected. The polish in ordinary atmospheres is permanent, the metal being non-corrosive to a very high degree. In the tempered state it is practically unaffected by salt water, but in the annealed form salt water affects it.

The chief difference between duralumin and other aluminum alloys is that duralumin has its physical properties materially changed by heat treatment which makes possible some peculiar production possibilities. At the same time the metal has certain definite limitations which demand that it be carefully handled and only used in designs which permit of the most advantageous use of its peculiar properties.

The most peculiar thing about duralumin is its behavior under heat treatment. The resulting change in its physical properties does not take place immediately but arises gradually, until complete about four days from the time of treatment. During this time the tensile strength increases 50 per cent or more, and the elongation increases from 600 to 800 per cent. Furthermore the metal in its heat treated form can be re-heated and softened for undergoing mechanical processes of not too violent a nature and after an hour it will return to its original tempered characteristics. It seems as though the metal could be seasoned—if such a word may be used. This delay in reaching the tempered properties of the metal is a great commercial advantage, as will be seen later.

The heat treatment of the metal, or the tempering as it might be called, is done by heating the metal to 920-940 deg. F. for from 7 to 30 min., the time being varied to suit the quantity of metal under treatment. After the metal has been treated it is quenched in boiling water after which it should be worked as soon as possible. In from one to two hours time sufficient hardening will have taken place to make the metal difficult to work. The process just outlined is thoroughly practical when the time involved in the working does not exceed one hour and the bending and hammering is not too severe.

In airplane work, for example, this will permit a roll of sheet metal to be heat treated, quenched, and passed through the shaping rolls inside of 20 min. after which the process is complete and the product is ready for ageing. The scope of this paper is not broad enough to include the technical details or a metallurgical study of this metal, instead some of the possibilities of its use will be pointed out—with special reference to aircraft construction.

The metal is a comparatively simple copper-aluminum alloy of the following composition:

Copper	3 50 to 4.00 per cent
Magnesium	0.2 to .75 per cent
Manganese	.40 to 1.00 per cent
Aluminum	(99 per cent pure) Balance
Physical properites:	
Specific Gravity	2.80
Weight per cu. in.	0.102 lb.
Melting Range, deg. C.	540 to 650
Compressive Strength, Tempered	44,000 lb./sq. ft.
Tensile Strength, Tempered	50 to 60,000 lb./sq. in.
Shear Value, Tempered	30,000 lb./sq. in.
Per cent Elongation, Tempered	16 to 20 per cent
Modulus Elasticity	106 x 10^5
Coefficient Expansion	0.00000226/deg. C.
Yield Point, Tempered	30,000 lb./sq. in.

Zinc is considered an impurity and care is taken to eliminate it as much as possible. For this reason duralumin is made only from the purest aluminum so that impurities in its components will not accumulate to a detrimental quantity. The inability of the Germans to obtain pure aluminum has prevented their duralumin from developing to the stage of ours here. The metal itself, however, was developed in Germany

*Paper prepared for American Society for Steel Treating.

from original French laboratory work. The first commercial use to which it was put, as far as the public is concerned, was in the Zeppelin rigid airships. One of the reasons for the slow development of these airships, aside from problems of design, was the necessity of developing the metal along with the structure.

In the first metal made corrosion caused considerable trouble, and sheets of it, seemingly without reason, granulated and had to be scrapped. Structures built of the early material were unreliable and required frequent inspection. This is still true of structures made of very thin gauge metal which has not been carefully heat-treated but with metal of reasonable thickness corrosion is rare. So that while the metal undoubtedly has its limitations it is not unreasonable to venture the opinion that, as engineers become better acquainted with it, its use will increase accordingly in all automotive industries.

Duralumin is an alloy and as such it is subject to troubles common to all alloys namely, impurities in the ingots of the constituent metals, or blow holes, small in their original form, but which, when the metal is worked out, develop into serious defects.

Most of the material used in airplane construction is of comparatively thin gauge so that a small speck of dirt can make a serious defect, and a small blow hole can make a considerable pipe in the sheets, both of which are almost impossible to locate except by microscopic examination plus a good deal of luck. Most of these flaws do not become apparent until after the metal has been rolled because the greatest stress is put on the metal as it goes through the rolls, and it is then that the product cannot be seen except with difficulty so that a highly polished dental mirror is used for the examination. Frequently a hole as small as a needle point is opened up into a flaw several inches long—a sort of stratification of the metal resulting from original ingot impurities.

In the initial stages of work with duralumin in this country spar rejections, as a result of the aforementioned flaws, ran as high as 400 per cent. This has gradually been reduced until now indications are that the rejections will be normal in the near future. In the work in which these rejections occur there has been no attempt at drawing the metal, it has merely been bent, as any attempt to draw the metal results in an extreme number of rejections due to cracking. These cracks may not appear until a number of hours after the piece is made, so that after the piece has been rolled four days are allowed to elapse before the completed product is inspected for cracks or flaws, and before it is used in an airplane structure.

Great care must be taken in the design of the rolls to prevent too great a degree of draw between annealings, and to allow a radius of sufficient amplitude for the metal.

The greatest trouble with the metal at present being used is the presence of ingot flaws, rolled out into serious defects which cause a very high rejection cost. When this trouble is remedied the experimental stage of duralumin will have been passed. When the demand for the metal increases to such an extent that the production of greater widths will be justified tubing and various structural forms will be available. The rolls at present in use only permit the production of sheets 16 in. wide.

Indications are that duralumin, as it develops, will take its place with steel for structural work. Its use in the aircraft industry is already definitely established as is evidenced by the way in which the all metal airplane is displacing the older types.

Instruments and Commercial Aviation

By C. S. Macdonald

The development of Aircraft in the future is clearly going to be along three lines, and it is a question if any one of the three is more important than the other. The first development will concern the airplane itself; the second, the landing fields, and service stations; and the third, the personnel which flies the planes.

Experience has taught us that a man may have had a brilliant flying record in the war and yet be unfit for commercial aviation, because all his training has been along combat lines, which necessarily means taking chances and depending to a great extent upon his skill. It was all right for war flying, where the pilot only had his own life to consider and the loss of it was an accepted incident. But the pilot who flies a commercial machine has not only his own life to consider, but also the lives of his passengers, the investment of his company, and the success of the enterprise. He, therefore, cannot afford under any circumstances to take what he knows to be chances. It is up to him to know that his machine is in the best possible shape at all times, and to see that it is equipped with every accessory which will make for safety.

A complete set of instruments, some of them even in duplicate, is the first requirement of every commercial airplane. There are no doubt hundreds of tug-boat and coastwise steamer captains who have been navigating the same ships, who could get about in any kind of weather without nautical instruments, and do it with a practical certainty, but not one of them takes the risk of navigating without proper instruments and charts, even though the element they work in is a great deal more stable than the air.

The pilot who relies entirely upon his senses of seeing, hearing and feeling is all right as long as none of these senses are dulled, or distorted; but the minute they are, he becomes comparatively helpless, and will get into positions much more dangerous before his dulled senses notify him of the danger, than he would have had he been able, as under normal conditions, immediately to detect the deviation which would have become instantly apparent, and been checked.

This is where instruments come in. They are a perfect mechanical substitute for the senses of the pilot and notify him immediately of any undesired action on the part of the plane long before he would notice it himself naturally.

The manner in which the various instruments are substitutes for the senses of the pilot is as follows:

A Turn Indicator is a substitute for the pilot's eyes when flying in fog or clouds where he could not check up his direction by sighting something on the ground. Its use permits him to steer in absolutely straight lines without seeing the ground, and makes it safe for him to follow his compass for direction, because it will not swing unless he encourages it to do so by conscious or unconscious turns.

A Banking Indicator shows the pilot whether he is slipping or skidding, whether in a turn or presumably flying level. This instrument will notify him of a slip or skid long before he could detect either by sense of sight or feel.

A Compass is indispensible on long flights regardless of weather conditions, because the surest way to fly to distant points is by compass course, backed up by the flight indicator. As an insurance of traveling in a straight line the compass will remain steady and can be relied upon.

An Air Speed Indicator can be used to great advantage in getting into small fields, by keeping the plane just above stalling speed, and referring to this instrument rather than depending on hearing and feel. Beside this, when flying in a fog or clouds, it will immediately indicate by its increase or decrease any change from the proper fore and aft level. In other words, it will show a decided increase if the airplane is nosed downward, and a decrease if it is nosed upward.

An Altimeter, especially of the modern post war manufacture, is extremely sensitive and accurate and can be entirely relied upon to indicate the altitude, when the ground itself is not visible. Further than this, it can be used to get a line on the best climbing angle of the plane at various altitudes, and a practical ceiling.

Gallaudet Electric Heat - Treating Furnace

It is a well recognized fact that advances made in design often force the development of improved methods of manufacture. Perhaps nowhere else than in aeronautics is there such a prompt discarding of apparatus and ideas when the cumulative pressure of advanced design makes itself evident.

Recent developments have brought to the fore the problem of all-metal structures and of the thick section cantilever wing, with the result that the heat treatment of steel and duralumin has become a manufacturing problem of first importance. The Gallaudet Aircraft Corp.. after discovering how real are the difficulties of this problem, found it necessary to design its own furnaces to treat the special shapes used in its machines. In particular, the usual large horizontal furnaces have proven unsuited for treating the long sections of the wing spars and the longitudinal stiffners of the fuselage, and as a result have forced the choice of the vertical furnace.

A quest for the best possible type caused an investigation of such designs as gun treating pits, the Snead electric direct heating machine and certain sectional unit heaters. The Snead type is limited at present in its application to work of uniform section and would have been too specialized an apparatus for the purpose. It was finally decided to construct a vertical electric furnace of the resistance type, built in sections, each having independent temperature control, and mounted above a deep quenching tank. The successful operation of this furnace has reflected well deserved credit on its builder, Chas. I. Hayes, of Providence, R. I., and has permitted the corporation to proceed in its new designs with the knowledge that this part of the manufacturing problem is solved.

General Arrangement

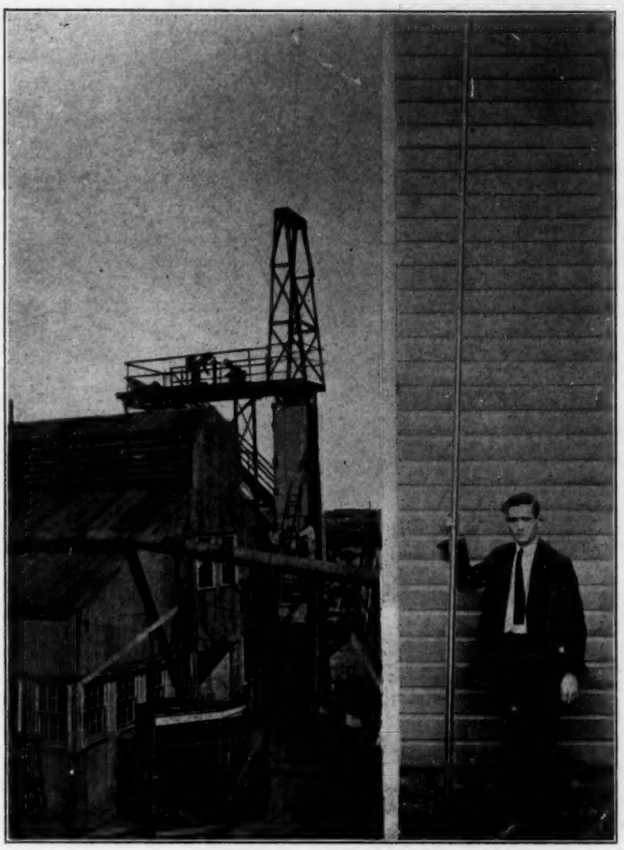
The general arrangement of the structure is shown in the accompaning illustration. The quenching tank is sunk five feet in the ground within a concrete lined well and extends to within 2 ft. of the bottom of the furnace. The oil depth is 17 ft. sufficient to quench any work which can be heated in 16 ft. 3 in. length of the furnace itself. There is an operating platform just below the furnace and a loading platform at the top, while above this extends a 17-ft. rigging tower. The total heighth of the apparatus is 55 ft., quite enough to make an excellent observation post as well as serve its more important function.

The whole tower has been sheathed with corrugated metal sheets for weather protection and to avoid too great a draft through the chimney-like furnace when the doors are opened.

Each of the five heating units has a ⅛ in. square hole through its length of 39 in. Recessed into the walls on all four sides of this chamber are the ribbons of the resistance grids which hang in vertical loops from the top of each section and are free to expand when heated. In this manner the work is subjected to the radiant as well as the convective heat of the grids, and no muffling action is obtained in the furnace. As a result the temperature is immediately responsive to control and a minimum of heat is absorbed by the walls, advantages which make for accuracy and economy in operation. Each unit has a rating of 48 amperes at 250 volts, the whole furnace taking 60 K. W. at full load. This is sufficient to bring the temperature from 60 deg. F. to a uniform heat of 1600 deg. F. in 75 min. The vertical draft through the furnace with top and bottom doors open will cool it off to 600 deg. F. in 30 min., so that rush work calling for a drawing directly after a quenching can be accomplished with reasonable celerity. Furthermore, because of the independent control of all sections, short pieces of work can be heated to the quenching temperature in the top of the furnace while the bottom sections are kept near the drawing temperature ready for immediate use.

System of Controls

The controls for the apparatus are all located on the ground within the adjoining building, all circuits being in conduit with junction boxes at each section. The grids in each section of the furnace are connected in series with a rheostat having the same maximum resistance and which is adjustable through fourteen steps and also with a single pole knife switch. By this means the watts absorbed and the heat developed can be varied from one-fourth to full load or else the entire section can be cut out. The sensitiveness of control which is obtained by this system in a vertical furnace has been a surprise, for temperature readings on all sections are readily held constant within limits of five degrees. The single Hoskins electric indicating pyrometer of the high resistance type is connected through a selective switch to thermocouples in the middle of each heating unit.



LEFT: THE GALLAUDET ELECTRIC HEAT-TREATING FURNACE. RIGHT: A 16-FT. CHANNEL SECTION DURALUMIN SPAR.

The tank contains 550 gal. of Houghton No. 2 quenching oil, which is used for both steel and duralumin parts with equal success. No provision has been made for cooling the oil as the normal radiation is sufficient to dissipate the heat absorbed from the relatively light sections treated. However, a Liberty engine water pump operated by an electric motor provides circulation in the tank, drawing from the bottom and discharging into the top.

Operation of Furnace

In actual operation the furnace requires the services of two men, one at the controls and the other on the loading platform. The work always requires "jigging up" for treatment. For the 16 ft. spar channels of the type illustrated, two of each size are held by sheet metal fingers with the concave sides together and the whole bound at intervals of a foot with iron wire. This forms a tube-like assembly which prevents this type of section from warping on quenching. Four of these assemblies can be drawn at the same time without warping, but only one can be safely quenched. Small parts are wired together in strings and if suitably chosen, lengths of ten feet of sheet metal fittings are treated without distortion at high temperature.

In charging the furnace, the work on the upper loading platform is attached to a rod long enough to reach through the furnace into the oil bath. The work is lowered into the furnace and the doors of cast Hardite are swung together, encircling the rod and guiding it. After heating, the main switch in the control room is pulled by the pyrometer man, and the bottom door is swung down and the charge lowered for the quench by the furnace man on the loading platform. The pyrometer man then detaches the work at the top of the tank and it is left to drain. For tempering the charge is lowered and withdrawn from the top of the furnace.

The advantages of this type of furnace for certain classes of work are definite and eminently desirable. Distortion can be prevented and initial curvature can sometimes be straightened by hanging a weight on the lower end of the piece, thus making gravity straighten instead of distort the material. Long pieces that are ordinarily awkward to handle, or a quantity of odd shaped small pieces, are speedily and simply transferred to the quenching tank by releasing a cable and "letting her drop."

Indeed, the whole apparatus has given the metallurgist better control over the time element in heat treating while he still maintains a very sensitive control over the working temperatures.

Balloon Propaganda Distributor

An ingenious mechanism constructed by a former Captain of the Air Service, R. C. Pierce, now a Consulting Engineer, at 30 East 42d Street, New York City, is believed to be the first instance in which a "Propaganda Distributing Device" that will automatically pilot free balloons has been developed. The work was done for the Air Service, McCook Field, Dayton, Ohio.

The mechanism is really a combination of two inter-functioning automatic devices, and is intended for the distribution of printed matter, manufacturers samples and other objects, including the dropping of small bombs, from free balloons. Incorporated in the mechanism is a special provision for arresting the descent of the balloon by the automatic release of sufficient ballast to restore the required degree of buoyancy to maintain practically a fixed elevation.

The first effort to distribute propaganda from the air occurred during the war, when airplanes were employed for the purpose; but the losses sustained were so heavy that the attempts were largely abandoned. This led to experiments with spherical balloons, owing to the fact that their path through the air can be forecast with comparative accuracy. The method of distribution was fairly successful but long flights were not possible as balloons without pilots or ballast throwing devices would soon come to earth.

The Pierce Propaganda Device weighs 35 lb., and is capable of carrying a useful load of 80 lb. The device is attached to a 300 ft. suspension cord close to the balloon, the cord trailing below like a drag line. Attachment to the cord is by friction rollers, which grip the cord and can turn only by rolling down its course. The rate of descent of the device along the cord is controlled by a small centrifugal governor. The device thus furnishes its own power much as in the case of the familiar "monkey on a cord" toy of our childhood days.

Turning with the rollers are shafts, threaded right and left, on which is hung the material to be distributed. If this is printed matter holes are punched at one end of the sheets. Rotation of the shafts causes the paper to feed off the ends and down through slots in the bottom of the waterproof cover of the device. Ordinarily twenty sheets per minute will be fed off in this manner, at which rate eight hours are required to distribute a full load of propaganda and bring the device to the end of the suspension cord.

The automatic pilot consists of a tight case containing what, to all intents and purposes, is a small gas holder. An increase of atmospheric pressure on descending will force the bell downward, closing an electrical circuit, current being furnished by dry cells. This throws in a clutch, causing a ballast shaft, having a coarse right and left hand thread, and carrying printed matter, to rotate one revolution and then stop. In this revolution sufficient ballast is released to check the descent. The electrical contact also opens a magnetic valve and restores the pressure equilibrium within the automatic pilot, and the device is reset for the next attempt of the balloon to descend. The time required to actuate the device is less than one second, and it is sensitive to descents of less than forty feet.

Provision is made to start feeding the propaganda at any desired time after the balloon leaves the ground, and also to destroy the device when all the propaganda has been distributed. With this device printed matter may be distributed at little more than postage rates.

N.A.C.A. on Airship Development

The National Advisory Committee for Aeronautics has sent under date of Sept. 17, 1921, the following letter to the President and the Secretaries of War and Navy:

"In accordance with action taken at a regular meeting of the Executive Committee of the National Advisory Committee for Aeronautics, held this date, I have the honor to transmit herewith the following resolution in regard to our aiship development policy which was adopted at said meeting:

"WHEREAS, Rigid airships have been primarily developed in Germany as a result of persistent efforts which could not be dampened by failures comparable to the recent destruction of the English-built ZR-2, and the practical application of such airships to useful purposes of war and of peace has been exemplified by the Germans:

"AND WHEREAS, the English have prosecuted the development of rigid airships with considerable success, patterning after German designs;

"AND WHEREAS, An official investigation is being made in England of the ZR-2 disaster which may determine the proximate cause of the accident itself, the conclusion is certain that whatever was the primary cause of the accident, the use of hydrogen was a contributing cause to the great loss of life.

"AND WHEREAS, America possesses the only large store of helium which is known to exist, by the use of which airships can be more successfully developed by America than by any other country for commercial as well as military purposes;

"AND WHEREAS, the present program of the United States in regard to the construction of rigid airships can be regarded only as extremely conservative;

"AND WHEREAS, It would be contrary to the true American spirit to abandon a conservative program because of one serious accident, when it is possible, by studying the cause of the accident, to profit by any mistakes that were made;

"THEREFORE BE IT RESOLVED, That the National Advisory Committee for Aeronautics is of the opinion that the development of rigid airships should be continued in this country; that sufficient funds should be devoted to experimental work for the obtaining of definite information regarding the strength qualities of materials and girders used in the construction of airships, and for the development and checking of the theories used in the general design of airships; and that the present program for the construction of the airship ZR-1 and for the production of helium should be prosecuted with renewed vigor;

"RESOLVED FURTHER, That the National Advisory Committee for Aeronautics believes it advisable that the Government of the United States should secure a recent type of German rigid airship, preferably directly from Germany, to fill the vacancy in the program caused by the loss of the ZR-2;

"RESOLVED FURTHER, That a copy of this resolution be sent to the President, the Secretary of War and the Secretary of the Navy."

Signed: JOSEPH S. AMES,
Chairman, Executive Committee.

The members of the executive committee who sat in at the meeting Sept. 15 when this resolution was passed were as follows:

Dr. Joseph S. Ames, Rear Ad. D. W. Taylor, Maj. Gen. Chas. T. Menoher, Rear Ad. Wm. A. Moffett, Maj. Thurman H. Bane and Prof. Chas. F. Marvin.

Soaring Flight*

By Prof. L. Prandtl

Director of the Aerodynamical Laboratory, Goettingen

By soaring flight—in contrast with gliding flight—is meant motorless flight without loss of height. According to the laws of the mechanics of flight, two sources of energy are available for soaring flight. One is, air currents having an upward trend; and the other is, irregularities in the natural wind. Under the latter head we can distinguish between two effective forms: (1) Great fluctuations in the strength (and also direction) of the wind, lasting several seconds; (2) The rapid fluctuation in wind direction which is commonly described as "turbulent wind". The fluctuations of long duration can only be utilized by effecting considerable changes in the velocity, and height of the machine, for instance, by climbing in one single gust, at the expense of relative velocity, and then, in the calm which follows, gliding with a downward acceleration. The procedure to follow in order to extract energy from the wind can be condensed into a simple rule: One must attempt to equalize the fluctuations in the wind. In so doing the energy in the wind fluctuations is obviously reduced, and the energy of the machine increased by a corresponding amount. Thus, for instance, great resistance must be presented against a gust, small resistance against a lull; in an upward current the machine must be gradually elevated to increase the pressure on the wings; in a downward current it must be depressed to decrease the pressure.

The fluctuations of short duration, on the other hand, can be utilized without any substantial change in velocity of the c.g. of the machine. As A. Betz has shown in a very instructive article†, useful effect is available in sufficiently great fluctuations in wind direction even with rigid and non-warped airplane wings. With elastically mounted or flexible wings, the force obtained from changes in wind direction, if these be sufficiently great, may assume perceptible proportions. The effect may be imagined as resembling that of the so-called fish-tail propellers. This name has been used to designate an arrangement by which the waves of the sea have been utilized for the production of power. The arrangement consists of a number of flexible plates, rigidly attached with their leading edge to the sides of a ship. As the waves rise and fall the plates bend like the tail of a fish, and produce power both when bent downward and when bent upward.

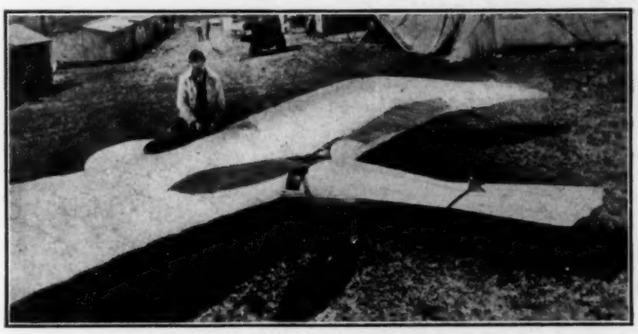
How the Birds Soar

When we now come to the question as to which of these sources of energy soaring birds utilize the answer can—at least as regards our domestic birds—only be that, if not exclusively at any rate mainly, they take advantage of rising air currents. Rising air currents are always to be found in uneven country when the wind is blowing. They are also caused over the plains by meteorological influences. For their flying practice birds naturally seek the rising air currents, and as these are frequently not of very great extent in space, the birds have to circle in order to remain in the rising air currents. By observing the soaring of birds of prey one may frequently see that they suddenly lose height and then commence to flap their wings, continuing in flapping flight until they are seen suddenly to rise. From this moment onward they commence to soar. They have again found their rising current which they had previously lost. The soaring seagulls near a steamer make use of the air deflected by the steamer and commence to flap as soon as, for some reason or other, they have to leave their favorable position.

That a bird intentionally makes use of gusts does not appear to occur generally. In order to do so it would have constantly to make jumps up and down, which, so far as I am aware, it has not been observed to do. On the other hand, it does not appear unlikely that many birds utilize in addition the rapid fluctuations in the wind, after the manner of the fish-tail principle. Probably, however, these forces suffice in no case to cover the entire work of flying, so that the axiom "no soaring without a wind with an upward trend" can probably be accepted as correct. It might be mentioned that in regard to sea birds, each individual wave gives the wind an upward deflection, of which the birds take advantage.

Human Soaring Flight

In the case of human soaring flight, all the previously mentioned possibilities of making use of the energy in the air hold good in principle. The fish-tail effect, as I will call it for the sake of brevity, may possibly be utilized by a suitable form of flexible wing-sections, although I should advise experiments with crewless models. It is probable that the wind fluctuations which such wings would be designed to



Soaring Machine, Entered in the Rhon Competition, which Has Auxiliary Power in the Form of Flapping Wings Worked by Pedals

(c) *Kadel & Herbert*

utilize, might frequently not be of such magnitude as to have a perceptible effect. In view of the probably inconsiderable gain to be expected one would not like to risk the uncertainty of the flying qualities of such a flexible aerofoil, which might easily lead to a useless,or even dangerous, machine. A crewless model, on the other hand, could more easily be sacrificed.

The utilization of great wind fluctuations is a question of the skill of individual fliers. It is conceivable now and then to extract a slight gain from these, but too much should not be expected from this source. There then remains, as the most important help to human soaring flight, air currents with an upward trend.

Utilizing Rising Air Currents

If it is desired to utilize to the fullest extent rising air currents one must strive to build machines endowed with a slow rate of descent. One is then in a position to utilize all rising air currents whose vertical component is greater than the rate of descent of the machine, provided that, at the same time, the upward slope of the wind is greater than the best gliding angle of the machine. On a slope which is steeper than the best gliding angle of the machine, it is moreover possible to soar in winds whose velocity is smaller than that of the lowest gliding speed of the machine, provided the rate of ascent of the wind is greater than the rate of descent of the machine. The machine will in this case soar out horizontally into the free air and will obviously rise in doing so. It would, however, in time get outside the region of the ascending wind, but if the slope has sufficient breadth the machine can be pointed diagonally to the slope and pass across it at the same height or climbing slowly, the sideways displacement giving sufficient speed for soaring. This method of flying can often be observed on seagulls over the beach. Under similar conditions the method should be possible of execution by human beings.

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* From *Zeitschrift fur Flugtechnik und Motorluftschiffahrt*, July 30, 1921. Translation by courtesy of *Flight*.

† A. Betz: A Contribution to the Explanation of Soaring Flight, *Zeitschrift fur Flugtechnik und Motorluftschiffahrt*, 1912, p. 269.

A Letter

EDITOR, AVIATION AND AIRCRAFT JOURNAL:

My attention has been called to an article in the Sept. 5 issue of AVIATION under the heading of 'Aviation Publicity' in which Mr. W. D. Smith, Director of the Bureau of Statistics of the American Express Co. gives his personal views on the subject of aviation publicity.

Mr. Smith comments on the official opening of our Key West-Havana service and on the flight of our two Aeromarine F5L boats from the Hudson River down to Key West. He states that the account he saw in the papers was a scant stick concerning the event.

We have on file in this office newspaper clippings regarding this particular event and I am happy to state that the New York papers featured this extensively both in special articles and in news stories.

Mr. Smith states that in his mind the channel of publicity through newspaper stories is practically closed. He also states that the newspapers do not take commercial aviation seriously.

Again I say that Mr. Smith is wrong because the newspapers not only of New York, but throughout the country have been keen to realize the possibilities that lie in commercial aviation. The operations of Aeromarine flying boats throughout the country have been widely circulated through the papers. In my opinion, the newspaper editors and publishers are men of broad vision and while they naturally do not print free advertising they unhesitatingly boost what they know is a good thing for the country, and that is the development of commercial aviation.

We do not ask for free advertising. When we have a news story we have no trouble in getting it printed. Why should we? On the flight which we recently completed over America's inland water-ways I found that the newspaper men and editors were our best friends. They went out of their way to help us.

Mr. Smith also says that very few people will read articles in the newspapers dealing with aviation. I beg to differ with him. The development of aviation today is in the minds of everybody. How can it be otherwise when American aircraft are establishing new records; when commercial flying boat transportation is being placed on the map?

Mr. Smith also says that the undercurrent of newspaper stories dealing with aeronautical activities has been one of implied, if not openly expressed frivolity. He also states that rarely, if ever, has he seen one of these stories written in a serious and comprehending manner. In New York City alone, where I have personal contact with most of the newspaper men who handle aeronautics for their papers, I know that most of these are ex-Air Service men, who know their subject and realize its future.

I have also become personally acquainted in the past year with most of the aeronautical men on newspapers throughout the country, and I have yet to see an article dealing with the development of a legitimate air service, which has been improperly or humorously handled.

There are a few individuals who have no standing and who every once in a while release "hot air" publicity about what they are going to do. Very often when it reaches the aeronautical men on the New York newspapers they refuse to print it, but sometimes this poor stuff gets in.

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THE EVENING MAIL AUGUST 26 19

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